Mission Systems
Capability Management

Version 2
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I. Background: PMA209 Air Combat Electronics (ACE) is responsible for the life cycle management of all Navy Air Combat Electronics systems and sub-systems. PMA209 is responsible for the acquisition, engineering, testing, integration, information technology insertion, open systems development, and life-cycle support of all Navy common avionics equipment. Under PMA209, Mission Systems is responsible for monitoring and managing the health of Naval Aviation Mission Systems to efficiently and effectively meet maritime strategy, CNO Guidance, OPNAV, and Headquarters Marine Corps (HQMC) direction. Mission Systems Integrated Product Teams (IPTs) develop and manage systems that provide aircraft mission capability processing, enhance situational awareness, support civil aviation mandates, and enable collaborative warfare in support of Fleet interoperability requirements.

II. Purpose: The purpose of Mission Systems Capability Management is to maintain technical expertise, continue in the development of funded products, and foster awareness of issues/coordinating activities across the Naval Aviation Enterprise (NAE). Mission Systems IPTs shall accomplish this responsibility through the development and maintenance of core acquisition and technical expertise for the strategic and tactical management of aircraft processors, displays, moving maps, and data transfer and storage systems in support of Naval strategic and operational objectives.

III. Scope: In accordance with DoD Directive 5000.1 and DoDINST 5000.02, Mission Systems will serve as the Lifecycle Manager for designated processors, displays, and data transfer and storage systems. Mission Systems will provide cradle-to-grave system lifecycle support from concept and technology development, engineering and manufacturing development, to production and deployment, and throughout the life of the system.

The following specific capabilities are included under Mission Systems management. The current capability and expected evolutionary activity of each area is defined in detail in the Core Avionics Master Plan (CAMP). Those items marked with an asterisk (*) have strong ties to and require significant coordination with other programs in PMA209 as indicated:

- Processing
    - Mission computers (i.e., Advanced Mission Computer, CDU, etc.) (*CNS/ATM)
    - Software (Mission critical and non-mission critical)
    - Common Application Programming Interface (API)
    - Control systems (*All)
    - Network processors (*CAN)
    - Portable computers (i.e., flight bags, kneeboard computers)
    - Auxiliary systems
    - Graphics cards
    - General Purpose Processor (GPP) cards
    - Digital mass storage devices (*CART)
    - Multiple Independent Levels of Security (MILS)

- Data Loaders / Recorders (*CART)
    - Common Data Loaders (i.e., ASQ-215, AMU, ADDS, etc.)
    - Flight Data Recorders

  - PCMCIA cards
  - External hard drives
  - USB storage devices

- Displays
  - Cockpit
  - Mission
  - Crew station
  - Auxiliary
  - Kneeboard displays
  - Graphics processors
  - Night vision compatible displays

- Map products
  - Moving maps
  - Map overlays
  - Integration of map related products (i.e., TAWS)

- Networks (Internal to Aircraft)
  - Fiber
  - Ethernet (including Gigabit (GB) Ethernet)
  - 1553 (Including E1553)
  - Wavelength Division Multiplexing (WDM)

The following items are specifically excluded from the management scope of Mission Systems:

- Flight control computers
- Heads up displays
- Ground based computers
- Ground based displays
- Crash Survivable Recorders (CSR) – all new CSRs will be coordinated through the Safety and Flight Operations capability team

Mission Systems will liaison with other program offices, various DoD organizations, Fleet representatives, and industry partners to communicate new and upcoming Mission Systems supported initiatives that may impact Naval Aviation Programs. To implement this strategy, the Mission Systems team shall:

- Maintain Awareness: The Mission Systems Deputy Program Manager (DPM) and Deputy Capability Area Manager (DCAP) will coordinate with AIR 4.5 Avionics Engineering, 4.1 System Engineering, 4.9 Research and Engineering, 5.1.2.3 Test and Evaluation competencies, platform PMAs, and other commodity PMAs to ensure adequate staffing and expertise levels for ongoing programs within Mission Systems. Subject Matter Experts (SMEs) are expected to maintain state of the art awareness of industry and academic initiatives within the mission systems field and are equipped to cover the complete mission systems spectrum. Mission Systems shall facilitate awareness across the NAE of mission systems related issues facing Naval Aviation

through the hosting of related conferences for the NAE such as the Future Airborne Capability Environment (FACE) Consortium, Common Avionics Architecture System (CAAS) User's Group meetings and conferences, and Avionics User Conferences. In addition, Mission Systems shall maintain a roadmap and assessment for all Naval Aviation platforms.

- Coordinate Requirements Reviews and Documentation: Mission Systems shall provide OPNAV (N88) and HQ Marine Corps a single point of entry into NAVAIR in matters concerning the establishment and review of mission systems requirements and documentation. Mission Systems shall coordinate the review of mission systems programs as applicable in the Joint Capabilities Integration and Development System (JCIDS) process.

- Develop and Coordinate Existing Programs and Program Issues: Mission Systems DCAP shall identify new programs or issues with ongoing programs and shall coordinate their development with platform program offices and resource sponsors.

- Explore Concepts: Mission Systems shall conduct studies and identify opportunities to prototype and/or demonstrate new mission systems concepts and initiatives to enhance current and future capabilities.

- Support the Commonality Opportunity Review Process: Mission Systems shall support the Commonality Opportunity Review Process (CORP) to ensure that there is focus on common system solutions across Naval and Marine Corps Aviation Platforms in order to reduce NAE total ownership costs, increase interoperability, and reduce the Warfighter's logistics footprint.

IV. Mission Systems Management: The Mission Systems Capability has evolved significantly over the past several years and will continue to evolve to meet the needs of its customers and stakeholders. This management area has evolved from primarily a provider of TAMMAC, AMC&D, ASQ-215, AYK-14 and Common Cockpit Systems to primarily a provider of moving maps, mission computers, displays, internal aircraft networks (including fiber channel, IPv6, 1553, E1553, Ethernet and extended Ethernet), and data loaders/recorders. In addition, there have been significant changes in the past years on how hardware and software systems for aircraft are managed.

In the past, Mission Systems has provided functionality through an acquisition program that develops and installs a physical box (Weapon Repairable Assemblies (WRA)) or configuration item)) with associated software that provides required capabilities or a set of functionalities. As technology has evolved, and as Mission Systems understanding and use of Open System Architecture (OSA) has increased, Naval Aviation has moved towards capabilities that are independent of particular hardware and based more so on software that can run on any number of different hardware systems. As such, there is significant focus on modular software that can run on a single processor, on multiple processors, on multiple types of hardware systems, and on multiple operating systems. This progression has allowed Mission Systems to compete hardware system procurements and then provide software from a library of software applications for the

needed functionality. These ideas are not new and have been developed and implemented in commercial systems for years. The Navy and Marine Corps face restrictions that prevent the wholesale use of commercial technologies and processes. The primary issue is the need to process, distribute, and manage classified data. This requirement will cause Naval Aviation to continue to manage system development in a more stringent manner than our civilian counterparts. Therefore, it is critical that Mission Systems Capability Management include a focus on capabilities within a security environment. As this may be considered an over-simplification of the significant technical issues involved, the fact is that all aspects of Mission Systems management will continue to move Naval Aviation in this direction.

With these changes in mind, Mission Systems has begun transitioning to embrace and utilize this new way of doing business. The organizational structure will change over time to reflect this new management philosophy. The organization chart shown below as Figure 1: Mission Systems Capability Plan is focused on capabilities, rather than programs and sets the stage for the management of mission systems, by capability. Each capability area will have a Capability Lead assigned who will serve as the primary point of contact for all new requirements.

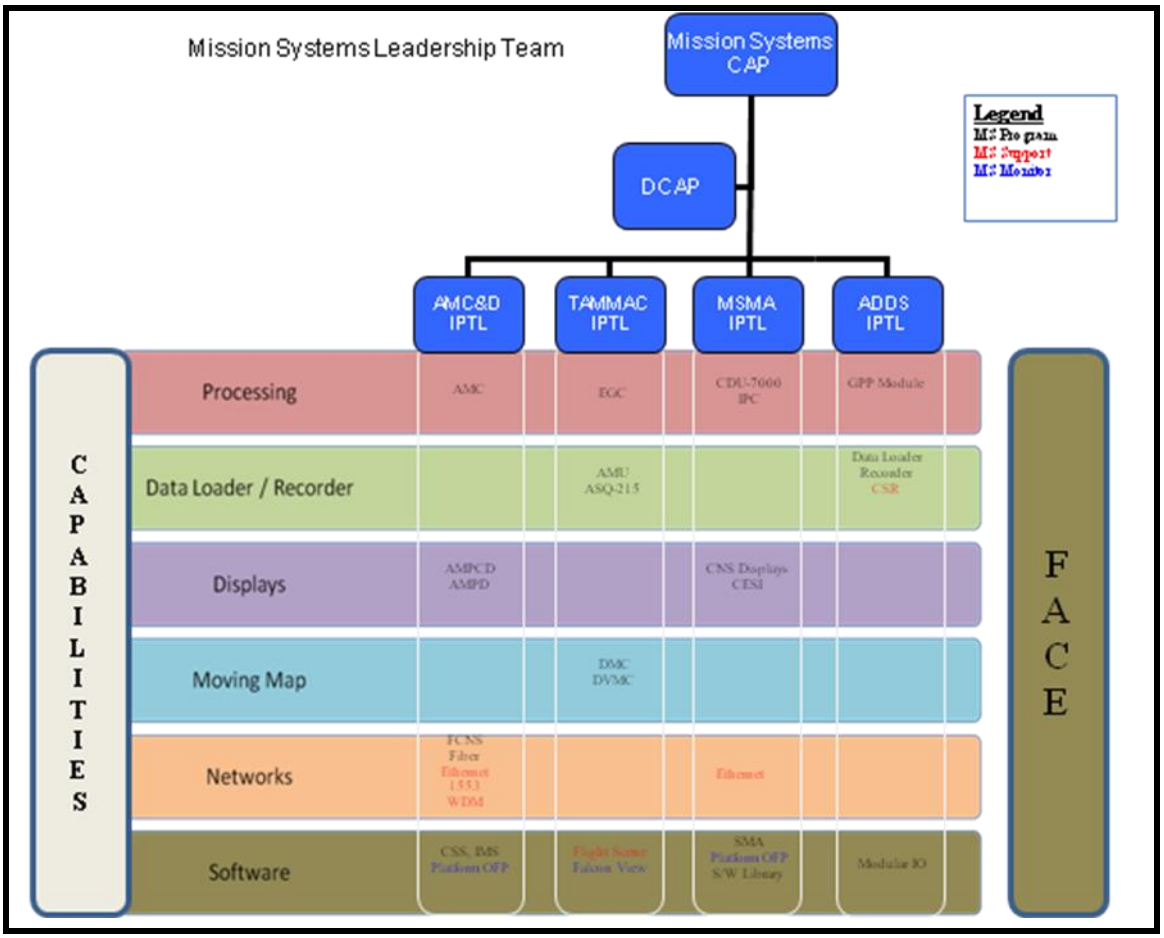

Figure 1: Mission Systems Capability Plan

Demand for Mission Systems capability varies significantly by platform. In order to provide the best solution at affordable costs, Mission Systems has established a Capability Leadership Team (CLT) led by the Deputy Capability Area Manager (DCAP) as shown in the organization chart below as Figure 2. The primary function of this team is to meet with platform customers, vet requirements, compare requirements to current common systems, determine if a current system can meet or exceed the new requirement, and work with the platform to implement the best possible solution from either an existing system or through a new system development program. This requires that the CLT be cognizant of systems both inside and outside of PMA209. Leads must be aware of new technologies that are approaching maturity and computer systems in platforms not supported by PMA209. Solutions will not be limited to current PMA209 systems but will be open to other systems that may have been developed by other program offices, through other services, and/or commercial systems.

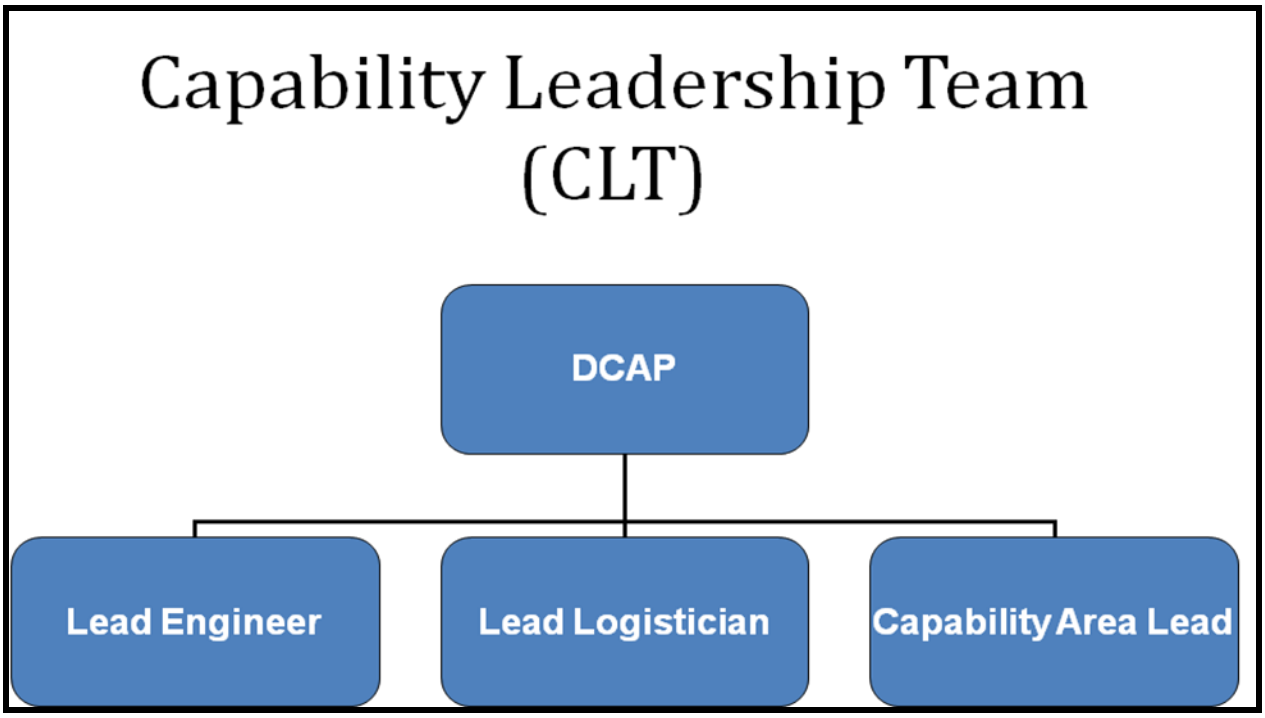

Figure 2: Capability Leadership Team (CLT)

V. Customer Requirements (Identification of Gaps): Requirements for Mission Systems come from multiple sources including OPNAV, HQMC, platform PMAs, other commodity PMAs, Operational Advisory Groups, Naval Aviation Requirements Groups, FMS customers, and other internal PMA209 programs. As previously discussed, the Capability Leadership Team (CLT) is responsible for collecting and evaluating requirements and looking for opportunities to provide solutions from existing systems or new development. If the CLT determines that the best solution is an existing program or an upgrade to an existing program, the effort will be passed to the appropriate IPT for planning and execution. If the determination is made that the best solution is a new acquisition, the effort will be passed to the PMA209 Board of Directors (BOD) for action. The BOD process for new work coming into PMA209 is outlined in the PMA209 Program Operating Guide (POG). The Mission Systems Capability Management Process is outlined in figure 3 below and shows how the Mission Systems process integrates with the PMA209 BOD process. If the BOD determines that the requirement is best filled by Mission Systems, a POA&M and program plan will be developed along with any required POM issue sheets required for execution. In all cases, the Core Avionics Master Plan (CAMP) is the document that will be used to capture baseline capabilities, planned upgrades, technology insertions, and funding status.

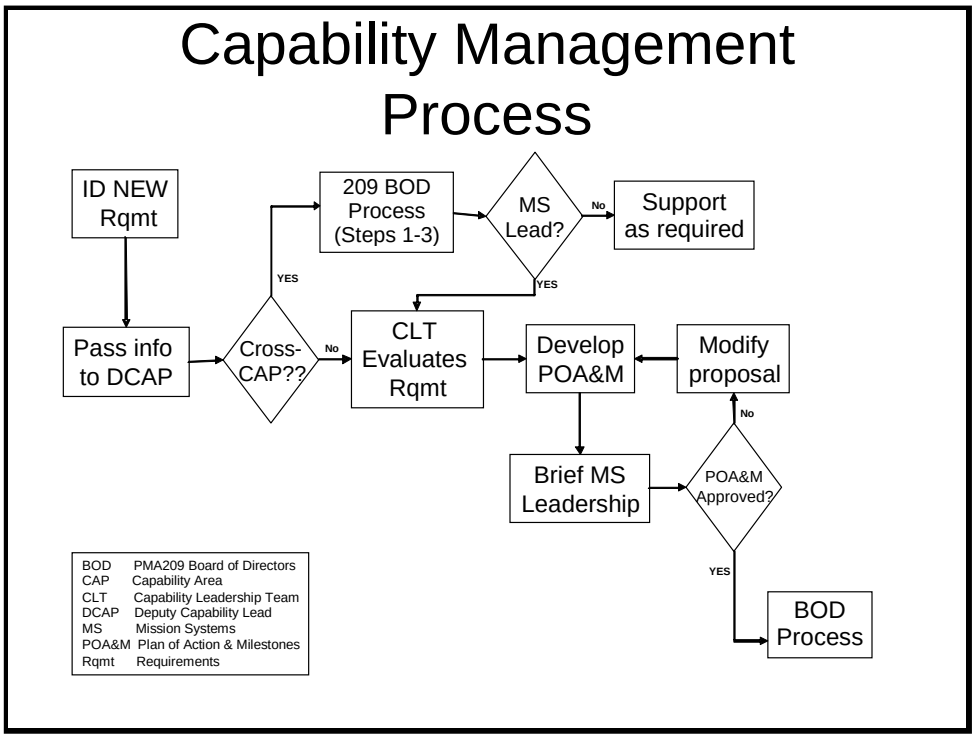

Figure 3: Capability Management Process

VI. Mission Systems Capabilities/Mandates: The Mission Systems capability areas and the primary platforms served by PMA209 are detailed below in Table 1: Platform Supported by Mission Systems Capabilities. Green indicates capabilities that Mission Systems is providing to each platform that is funded and installed on at least one aircraft. Yellow indicates capabilities that MS has plans for future platforms. Light Blue indicates capabilities that MS is currently in discussion with the platform to determine the best way to provide the capability. Below the table is a discussion of specific gaps and mandates along with the current plans to address them. More information on these may be found in the PMA209 CAMP.

Table 1: Platform Supported by Mission Systems Capabilities

Platform	Processing	Map	Data Loader	Mission Recorder	Displays	Networks
USMC						
AH-1W	CDU	Flight Scene	ASQ-215	ADDS		
AH-1Z	CDU	Flight Scene	Interim	Interim		
AV-8B	AMC	TAMMAC	AMU	AMU	AMC&D	
CH-46			ASQ-215			
CH-53D			ASQ-215			
CH/MH-53E	CDU	Flight Scene	ASQ-215	ADDS	MSMA	
CH/MH-53K	CDU	Flight Scene	ADDS	ADDS		
EA-6B	AYK-14					
F-35B						
KC-130J	PMA 207		ASQ-215			
KC-130T	CDU/IPC	Flight Scene	ASQ-215		MSMA	
MV-22B			ASQ-215			
UH-1Y		Flight Scene	ASQ-215			
CV Airwing						
E-2C	CDU	Flight Scene	ADDS	DMD	MSMA	
E-2D	CDU	Flight Scene	ADDS			FCNS
EA-18G	AMC	TAMMAC	AMU	DMD	AMC&D	FCNS
F/A-18A+	AYK-14		AMU	DMD		
F/A-18C	AYK-14	TAMMAC	AMU	DMD		
F/A-18D	AYK-14	TAMMAC	AMC	DMD		
F/A-18E	AMC	TAMMAC	AMC	DMD	AMC&D	FCNS
F/A-18F	AMC	TAMMAC	AMU	DMD	AMC&D	FCNS
F-35C						
MH-60R		Flight Scene	ADDS	ADDS		
MH-60S		Flight Scene	ADDS	ADDS		
Patrol/ISR/C2						
BAMS UAS	BAMS Unique					
E-6B						
EP-3						
MQ-8B						
P-3C	CDU	Flight Scene	ASQ-215		MSMA	
P-8						

Legend:

Funded / Installed	In Discussion
Future Planned	A/C Unique

1. Processing

Processing includes any manipulation of digital information and data, and includes both the hardware, software environment and software applications for all mission systems on Naval aircraft. In the past, Mission Systems focused primarily on the hardware required to run mission systems applications with the platform program office managing the software Operational Flight Program (OFP). Today, all Navy and Marine Corps aircraft have mission computers that are closely coupled to their OFP and have to be maintained together. Obsolescence issues with the computer hardware require redesign of the circuit board containing the obsolete parts at often very high costs. The OFP software is often "spaghetti" code that requires significant apriori knowledge in order to update and test it. Some aircraft OFPs have been modernized and have more modular code (i.e., F/A-18E/F). However, even these are proprietary and not partitioned so that only the prime can affect changes to it and extensive testing is still required for all new capabilities.

Modern computer systems have opened the way for a change of focus from hardware centric to software centric solutions where the hardware is independent of the software applications and can be procured separately as long as the hardware is capable of running the software environment. The Future Airborne Capability Environment (FACE) is a PMA209 initiative to define a common software architecture that will allow Naval aircraft to become hardware independent and to procure or develop capabilities based on software running in a FACE compliant hardware environment.

a. Future Airborne Capability Environment (FACE)

The plan for implementation of FACE begins by defining the standard for the environment and the business model for implementation. These will be developed through participation in a government / industry / academia FACE Consortium being sponsored by The Open Group. The consortium now has 23 member organizations including aircraft primes, operating system vendors, hardware vendors, software vendors, and Army and Air Force representatives. Version 1 of the standard will include the definition of the "vertical stack" or the hardware to application layer interfaces. It will also include the initial version of the Business Model Guide. Version 1 is due to be released by the Open Group in May 2011. Version 2 will include the horizontal or data sharing standard and is due to be release in 2012.

It is important to note that not all issues associated with FACE have been resolved. The ones that represent the most risk include how to handle software licenses, who will be responsible for integration of capabilities from the software library into aircraft platforms, and how to address updates to the standard. Mission Systems will continue to push the state of the art and prove out these concepts so future mission systems will be modular and scalable, thus reducing test requirements, cost, and schedule to bring Naval Aviation closer to a common

operational picture using common software. This is the objective of FACE and will be the main focus of all future Mission Systems development activities.

Once the standards are developed, implementation of FACE will follow one or all of the three models below.

1) The FACE standard will be included as a requirement on all new acquisitions within PMA209 and upgrades to existing systems wherever possible within budget constraints. The current plan calls for FACE to be included in the Advanced Digital Data Set (ADDS) procurement and the C-130T cockpit upgrade procurement, both scheduled for RFP release in July 2011
2) A FACE CORP project was initiated in January 2011 to plan for POM-14 issue sheets for platform requirements that could best be met using a FACE architecture. The first step is to determine capabilities required by each platform participating in the FACE CORP. A final set of common requirements will be evaluated for cost and schedule and issues sheets will be generated. The plan is for each aircraft platform to act as the lead for one of the new capabilities. Each will be developed using the FACE standard. Once developed, the software for each capability will be made available to all of the other aircraft platforms so that all of the capabilities will be implemented on all of the platforms while only paying for the development of the capability one time.
3) Once the FACE standard is developed, any aircraft platform can use it to develop a FACE conformant environment either in an existing computer or through the integration of a new computer.

2. Data Loader / Recorder

Larger file sizes and increasing load times are driving a requirement for greater transfer device capacity and higher interface speeds. Current fielded data loader / recorder devices include the ASQ-215 Digital Data Set (DDS) (PMA209), the Digital Memory Device (DMD) (PMA265), and the Advanced Memory Unit (AMU) (PMA209). These devices are used to load mission planning information and to record mission replay information. Hardware obsolescence in these devices presents an opportunity for development of a common solution that leverages emergent COTS data transfer and memory technologies. PC cards are being replaced in commercial practice by faster, more rugged interfaces such as PCExpress or USB drives. Increased capacity is also required for higher fidelity digital terrain geo-referencing data in support of terrain and obstacle avoidance during low level missions or rotorcraft recovery in degraded visual environments. In order to address these requirements, Mission Systems is leading a new start program for FY11 to develop a state-of-the-art data loader, recorder, crash survivable recorder, and general purpose processor. This program, entitled Advanced Digital Data Set (ADDS), will provide these capabilities in a modular hardware architecture so that platforms can mix and match these modules to obtain the required capabilities for that platform. In addition, this system will be the first system designed from

the ground up to be FACE conformant. This program is funded through RMD 700 funding and a POM-12 issue sheet for H-60 and MH-53K aircraft. ADDS is also being developed with a plan to illuminate the type of obsolescence issues that have been seen on all current data loaders using PCMCIA cards. ADDS will procure complete data interface between the ADDS box and the Removable Memory Modules (RMM). As memory technology improves, ADDS will be able to recompete the RMM to avoid obsolescence issues and to take advantage of increased memory and speed.

Mission Systems is leading the development of ADDS to replace all data loaders currently in the fleet. The goal is to provide the next generation data loader, storage, and recorder in one unit that is common across platforms and that incorporates MILS and anti-tamper requirements. Other platforms have shown interest in the ADDS family of systems and are pursuing POM-14 issue sheets for integration, test and fielding of ADDS.

3. Displays

Significant advancements in commercial display applications are making their way into military cockpits. Most Naval Aviation cockpits have integrated display technologies to support night vision devices and operations in very low levels of illumination. It is even more challenging to develop adequate contrast and illumination levels in the very bright daytime environment of a tactical cockpit. The two primary leading technologies currently being integrated are Light Emitting Diode (LED) and Active Matrix Liquid Crystal Display (AMLCD) products. S&T efforts are looking at OLED technology as the future of displays. MS will continue to monitor S&T and SBIR activity to stay abreast of display technology.

AMC&D, and MSMA displays form the start of a family of displays that should be able to satisfy the requirements of all Naval Aviation platforms. Apart from these centrally managed displays, military cockpit and cabin displays are principally managed separately for each platform. Mission Systems will start a CORP project in FY-12 to look at the potential of managing displays in a common manner with a commodity team. The CORP project will investigate capabilities and life cycle costs to develop and integrate a common family of displays.

4. Digital Maps

Tactical Aircraft Moving Map Capability (TAMMAC) is the most common moving map system in Naval Aviation platforms. While TAMMAC has been the moving map of choice for Naval Aviation, new map products continue to come on the market with improved features, such as modularity for execution on multiple hardware and operating systems configurations, smaller footprint using less memory and processing power, and ability to include other applications such as weather, ADS-B, and Blue Force Tracker (BFT). Mission Systems has shifted focus from providing only TAMMAC as the single moving map solution to providing solutions that fit individual platform requirements. As such, the commercially based FlightScene moving map is being supported, as well as, development of a stand-alone

card that can be incorporated into multiple computers and that is capable of running TAMMAC software, FlightScene, and any other map product that is currently available to military aircraft. Since there are numerous moving map products available today in software only solutions, we do not anticipate that there will be any new development map program for Naval Aviation. Mission Systems will continue to stay cognizant of moving map technologies that offer the best solutions to the Warfighter while maintaining commonality where possible. Once the FACE standard is published, MS will work to ensure all moving map applications are completely FACE conformant and are included in the FACE application library. The team will work with platforms to insure their requirements are being met by at least one of the software moving map applications. As new applications and overlays are added, the moving map team will strive to maintain a common approach for implementation and display including the use of MIL-STD-2525 symbology and new file formats such as Vector Map format.

5. Networks

For information transfer within the aircraft, the most widely used standard is MIL-STD-1553 bus protocol. Current 1553 bus attributes, including extensive availability of hardware (many providers), simple component interface, relatively low latency, adequate cable run, good fault isolation and relatively low cost have driven nearly universal incorporation across Naval Aviation in the last two decades. 1553 bus, however, is limited to 1 megabit/sec data (Mbps) transfer. While this data transmission rate remains suitable for many current command functions such as flight control and munitions deployment, it is too slow to serve the increased peer-to-peer communications needed by avionics applications in support of data, audio and video information exchange. Standard Ethernet supports 10 Mbps, and bandwidths are growing. "Fast Ethernet" supports 100 Mbps, and "Gigabit Ethernet" supports 1 gigabit/sec (Gbps). Modern platforms are using fiber channel networks to move data, which also supports a standard of 1 Gbps, and has demonstrated near term potential growth to 4 Gbps.

While this is becoming a significant issue for some platforms, there is no defined requirement to improve aircraft networks or to increase information transfer rates. Mission Systems continues to be at the forefront and is fully versed in all of these new potential solutions, working to identify the next generation standard for all to follow. A future CORP project is being planned to address data transfer requirements. The result should be a cost effective, common solution for Naval Aircraft.

VII. Technology Push: As innovative technologies are identified for their potential benefits for future Naval Aviation systems, they will be assessed for inclusion in PMA supported Small Business Innovation Research (SBIRs), future upgrades to existing systems, new development systems, and/or demonstrations to prove the technologies. Once these technologies have been shown to provide benefit to Naval Aviation platforms, they will be captured in the Core Avionics Master Plan (CAMP) and shared with customers of products that might benefit from these advancements.

VIII. Supporting Documents: Supporting documents that contain further descriptions of the aforementioned concepts, programs and equipment discussed in the paper.

- Core Avionics Master Plan (CAMP)
- Next Generation JPDO Avionics Roadmap
- N84 Avionics 2025

IX. Appendix A: Acronym List

ACE	Air Combat Electronics
ADS-B	Automatic Dependent Surveillance Broadcast
ADDS	Advanced Digital Data Set
AESA	Advanced Electronically Scanned Array
AMC	Advanced Mission Computer
AMC&D	Advanced Mission Computer and Display
AMLCD	Active Matrix Liquid Color Display
AMU	Advanced Memory Unit
API	Application Programming Interface
APMCD	Advanced Multi-Purpose Color Display
APMD	Advanced Multi-Purpose Display
BFT	Blue Force Tracker
BOD	Board Of Directors
CAAS	Common Avionics Architecture System
CAMP	Core Avionics Master Plan
CAN	Communications and Airborne Networking
CART	Common Aircraft Recorder Team
CDU	Computer Display Unit
CESI	Common Electronics Standby Indicator
CLT	Capability Leadership Team
CNS/ATM	Communication Navigation Surveillance / Air Traffic Management
COTS	Commercial Off the Shelf
CSAD	Cabin SA Device
CSR	Crash Survivable Recorders
CSS	Core System Software
DCAP	Deputy Capability Area Manager
DDS	Digital Data Set
DMC	Digital Map Computer
DMD	Digital Memory Device
DVMC	Digital Video Map Computer
EGC	Embedded Graphics Card
FACE	Future Airborne Capability Environment
FCNS	Fiber Channel Network Switch
GB	Gigabit
GPP	General Purpose Processor
HOL	High Order Language
HQMC	Headquarters Marine Corps
IPC	Inter-Process Communications
IPT	Integrated Product Teams
ISS	Image System Software
LED	Light Emitting Diode
MFD	Multi Function Display
MILS	Multiple Independent Levels of Security
MOSA	Modular Open Systems Architecture

MSMA	Mission Systems Management Activity
NAE	Naval Aviation Enterprise
NARG	Naval Aviation Requirements Group
NGA	National Geospatial Agency
NSA	National Security Agency
OFP	Operational Flight Program
OSA	Open System Architecture
PC	Personal Computer
POG	Program Operating Guide
POM	Program Objective Memorandum
SBIR	Small Business Innovation Research
SMA	Systems Management Activity
SME	Subject Matter Expert
SPG	Strategic Planning Group
TAMMAC	Tactical Aircraft Moving Map Capability
WDM	Wavelength Division Multiplexing
WRA	Weapon Repairable Assemblies